A principal component-based radiative transfer forward model (PCRTM) for vertically inhomogeneous cloud

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A principal-component based radiative transfer model (PCRTM) is developed for simulating the infrared spectral radiance at the top of the atmosphere (TOA). The PCRTM approach removes the redundancy in radiative transfer calculation in high-resolution infrared spectra, and saves significant amount of computational time with great accuracy.

In PCRTM, both ice and water clouds are treated as effective transmissivity and reflectivity stored in a pre-calculated lookup tables. These quantities are calculated using cloud single scattering properties such as cloud optical depth, cloud particle size, cloud phase, *etc*. The cloud can be inserted into any pressure layer in the PCRTM model (up to 100 layers). The effective temperature of each cloud layer is treated as a function of its optical depth.

To test the accuracy of this approximation, the results are compared with the more rigorous DISORT model, which treats cloud as a plane parallel layer. The root-mean-square error of PCRTM, with respect to DISORT results, is generally less than 0.5 K in brightness temperature. However, the CPU time required by PCRTM was approximately two orders of magnitude less than that required by DISORT.